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A STUDY OF NOTEBOOK AND LABORATORY WORK AS AN EFFECTIVE AID IN SCIENCE TEACHING

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There have been two problems confronting the science teachers in our high school. The first one is, can we cut down on the notebook drudgery without endangering the efficacy of our teaching? and the second one, how closely should we adhere to the rule that all experiments must be performed by the pupil himself?

Previous to this year the laboratory work has been done either by the whole group working individually on the same experiment at the same time, or, in case the necessary apparatus was too expensive to be purchased in large numbers, by the rotation method. This latter has proved unsatisfactory as the pupils do not receive adequate guidance from the instructor, and this year we have substituted for it demonstrations by the teacher with notebook record by the pupil.

A test was recently given to ascertain the relative effectiveness of various types of laboratory instruction, as shown by the pupils' recollection of experiments performed several months before. Only the memory feature is considered—what are the best aids to "fixing" the desired impressions? The test is by no means conclusive concerning other benefits derived from laboratory work, manual skill, confidence, ability to follow written directions, and the like.

Attempt was made to select experiments of equal interest appeal, and, as the test was not contemplated at the time, they were performed under normal teaching conditions. A group of physics students was examined in three types of experiment: that which the pupil had himself performed and recorded in his notebook; that which had been performed by the instructor and recorded, calculations and conclusion made by the pupil; and the ordinary demonstration experiment performed by the instructor, and discussed by the class, but no notebook record made.

For each type of experiment the answers were marked for three features, (*a*) description of apparatus and materials; (*b*) method;

(*c*) nature of data and conclusion drawn, and each feature was graded as either complete and accurate, acceptable, or not satisfactory. The results as follow give percentage of papers falling in each class.

Kind of Answer	Apparatus	Method	Conclusion
Complete and accurate			
Individual with record	63	48	22
Demonstration with record	63	44	30
Ordinary demonstration; no record	45	26	26
Acceptable			
Individual with record	11	26	26
Demonstration with record	15	26	22
Ordinary demonstration; no record	22	44	26
Unsatisfactory			
Individual with record	26	26	52
Demonstration with record	22	30	48
Ordinary demonstration; no record	33	30	48

Examination of the first column of the table shows that the writing of the notebook record is more effective than manipulation in impressing upon the pupil the details of apparatus and materials. The fact that an even larger percentage falls in the unsatisfactory part of the column from the first type than from the second is probably due to the more specialized apparatus being more readily recalled. The failure of the unrecorded experiment to fix details of apparatus is very marked.

In the second column, likewise, it is noticed that the complete details of procedure are more permanently fixed when a written record is made. A large percentage of the pupils are found accurate in statement of method when they themselves have carried out the work. The two demonstration experiments show the same number of unsatisfactory answers, indicating that the value of the notebook record here is in fixing details of procedure and not the general knowledge of the method.

In the last column we find the results of the two demonstration experiments more clearly interpreted than when the pupil does the work himself. Here again the notebook record is instrumental in fixing the impression made by the demonstration. The failure of the pupil's own experiment to bring definite conclusions may be due, in part, to the fact that they received less class discussion than the other two types. In the unsatisfactory list both demonstration experiments have the same representation, indicating that the advantage of the notebook lies in securing accuracy of statement, and that pupils get a "general idea" as well without such record.

It seems evident that, in the case of the experiment which the pupil performs himself, his attention may be so focused on details of apparatus and manipulation that he misses entirely the object of the experiment, while in the case of the demonstration experiment, relieved of the embarrassment of manipulation, he may and does direct his main attention to what happens and what it means.

We draw the following conclusions from the test: first, the laboratory experiment has no advantage over the demonstration in teaching a law of physics; secondly, the laboratory experiment has value in familiarizing pupils with apparatus and methods of procedure; thirdly, notebook recording is valuable in securing definiteness of information. From these conclusions a number of suggestions may be made.

There should be a decrease in the number of general laboratory experiments performed by the pupil with a higher standard of accuracy set and a more careful discussion made. This laboratory work should furnish training in careful manipulation, an appreciation of the finesse of measurement, and a confidence in apparatus which can be secured only by working with it.

In place of the laboratory experiments omitted, substitute demonstration experiments to be recorded in notebooks. Especially there should be demonstration of laws and principles where interpretation of data is not obvious and discussion is required.

Whether or not the record of a demonstration experiment is to be included in the pupil's notebook, if it is desired that he have some definite knowledge of its details, insist upon a formal write-up.

Make use of the notebook as a valuable aid to teaching—and learning.